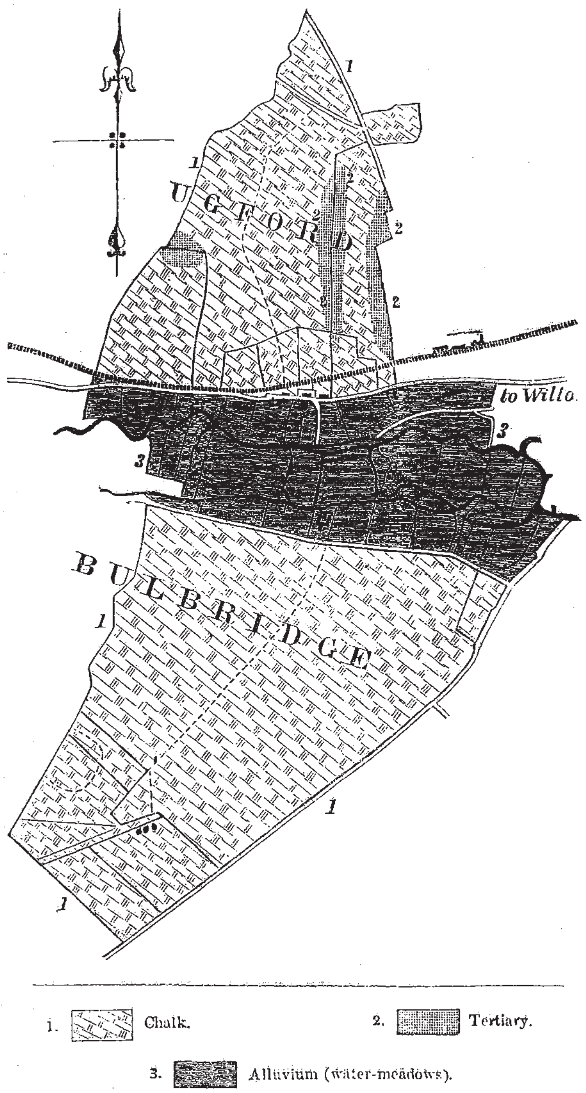
inspection of the districts by Mr. H. M. Jenkins, the recently elected Secretary of the Society; who, fresh from his labours as Secretary to the Geological Society of London, has given, in addition to an insight into the methods employed for improving the land, very clear and accurate sketches of the geology of each farm over which he has gone, illustrated in each case by a shaded map, expressing the nature of the subsoil, and its bearing upon both the lithological nature of the soil, and its retentiveness of moisture—this latter point having a most important bearing upon its fertility.



Subsoil Map. Scale—Two inches to a mile.

In illustration of the various conditions under which the surface soil is cultivated, we may refer our readers, first of all, to the recently issued number of the journal referred to. We there find, in an essay on Forest-farming, by Mr. Jenkins, that "the site of the ancient forest of Sherwood furnishes some of the best examples in England of successful farming, under circumstances of great natural difficulty. The subsoil consists of a sandy conglomerate, and is covered by a very light sandy loam of poor and hungry character. Little is yielded by it alone; and the farmer looks upon it more as a vehicle whereby he can convey fertilising materials to his crops, than as a producer of their natural food." Here we have a natural condition of virgin barrenness, forced into fertility by the most advanced appliances of agricultural science; and from this basis of natural poverty we may diverge, on the one side, into fields which, once naturally fertile, and possessing a rich store of accumulated wealth, have been impoverished, and even *denuded*, of their wealthy mantle of soil at any rate, by a very recent degradation; and, on the other side, we may find examples where the wealth and fertility of a district are being continually increased by atmospheric causes. Mr. Jenkins gives us instructive examples of both sets of conditions, in one case both occurring on the same farm, viz. at Eastburn in the Yorkshire Wold: on one portion of the farm "the higher ground exhibits a soil gradually *increasing* in strength and depth as one ascends the hill;" while upon another portion of the farm, the thickness of the soil follows a rule precisely opposite to that just noticed: "instead of the depth and strength of soil increasing with the height, the opposite is now the case. The only essential physical difference in the two cases seems to furnish the explanation of this anomaly, namely, that we now have to deal with a *wet* valley of very slight slope, the soil on the sides of which consists of the mud (or warp) deposited by the stream in times gone by; whereas, in the other case, the valleys are dry, and their slopes have been denuded of any alluvial soil which may formerly have covered them, by an agency which has also deepened the valleys and increased the pitch of their sloping sides." All these practical descriptions, the result of actual survey, show clearly that the formation of soils is not always attributable to the same cause; for we have in them clearly indicated three natural processes by which the surface-conditions have been produced—viz. (1) Soil formed from the subsoil immediately beneath; (2) Soil formed by the denudation of soil and subsoil at higher levels; and (3) Surface denuded of soil by degrading influences. The first two processes are *formative*, while the third is *destructive;* and thus in this, as in every other portion of nature's economy, we at last learn that antagonism produces equilibrium.

H. Woodward

VEGETABLE PALÆONTOLOGY

Traité de Paleontologie Végétale. By Prof. Schimper. (Paris, 1869 London: Williams and Norgate.)

If asked to indicate the most suggestive discoveries in Geological Science that have been made within the last ten years, we should unhesitatingly point to that of the Eozoön,—to the unfathoming of the mysteries of the floor of the ocean,—and to the unearthing, in high Arctic regions, of forests of Dicotyledonous trees, not merely analogous in size, habit, and conditions of life, but specifically closely allied in structure to the forest trees of middle and southern Europe, Asia, and North America. The first of these discoveries carries back the history of life on the globe over a period indefinitely anterior to that which so long marked its starting-point; the second reveals a condition of life far lower than any hitherto discovered, if not the primordial condition of organized matter itself, and is the clue to the history of the chalk, the most complicated in its relations and the richest in animal remains of all known formations; whilst the third, the most simple in its outlines and the most intelligible in its facts, has hitherto checkmated every attempt to reconcile the stubborn conclusions of astronomers, in so far as these relate to the recent history of the globe, with the palæontology of a period comparatively but little antecedent to our own in a geological point of view.

Thus it is that Geology, which in its infancy was the offspring of mineralogy, chemistry, and mechanical laws, has fallen while still young under the step-fatherhood of Biology; even the superposition of strata meaning nothing, if not supported by Palæontology, since the fact that an upper stratum of rock containing organic beings of simpler structure than that it overlies is held to be sufficient proof of their original positions having been reversed, notwithstanding all appearance to the contrary. Biology, in short, supplies the weights, wheels, and pendulum of the geological clock, of which Zoology has hitherto marked the hours, and Botany, at uncertain intervals, the minutes.

Lately, however, owing chiefly to the exertions of Heer, Massolongo, and Saporta, following the footsteps of Unger, Braun and Goeppert, Botany has gained a little of its lost ground in the race with Zoology for precedence as the handmaid of Geology. The number of species collected and arranged in the cabinets of Zürich, Vienna, Breslau, &c., has been prodigious; lucky discoveries of structural specimens have thrown clear light on the affinities of whole groups of obscure fragments; and the constant association of certain leaves with certain fruits, seeds, and flowers has led to many more very probably correct, or at least approximate, identifications. As usually obtains with a science under such conditions, the publication of new species on mistaken and uncertain grounds, or on no grounds at all, has proceeded rapidly, whilst the acquisition of a real knowledge of the objects themselves has been slow. Superficial naturalists, who think they know an oak, a laurel, or a fig-leaf when they see it, but who neither really do know these, nor the multitude of other vegetables whose leaves imitate them, have boldly made fossil species of such genera; shielding themselves under the belief that, let botanists doubt as they please, they cannot contradict.

For years this state of things has gone on; the Devonian, Carboniferous, Eocene, Miocene, and Pliocene floras have been the prey of adventurous systematists; while with the exceptions of Brongniart and Lindley no naturalist eminent for his knowledge of exotic forms of vegetation has attempted a general work on fossil plants; and that these great men simultaneously broke down, is notorious. Thirty-two years have elapsed since the suspension of the "Fossil Flora of Great Britain" by Lindley and Hutton, and of the "Histoire des Vegetaux Fossiles," by Brongniart. In this interval, but one other general work of the same nature has appeared, the "Genera et Species Plantarum fossilum," by Unger, a careful compilation by a very accomplished palæontologist of Vienna; but many excellent treatises on the vegetation of individual formations have been contributed by able men, amongst whom rank especially—on the Continent, Heer, Unger, Ettingshausen, Massolongo, de Gaudin, de Sismonda, Otto Weber, de Ludwig, Goeppert, Saporta, and de Watelet, and the author of the work now under notice,—in England, Bunbury, Binney, Williamson, and Carruthers, —and in America, Lesquereux, Dawson, and Hall. The time, therefore, has fully come for a complete review of the Fossil Flora of the globe, and it has fortunately fallen into hands which in very many respects are the best fitted for carrying it out with success.

Dr. W. Ph. Schimper is Professor of Geology in the Faculty of Science at Strasbourg, and Director of the Museum of Natural History in that city, an institution which is, we are told, largely, if not wholly, indebted to his liberality and energy for its present value and condition. Dr. Schimper is further a correspondent of the Institute of France, and of the Linnæan Society of London; the best living Muscologist, and the author of a monograph of the Fossil Plants of the Vosges, and of a work on the Palæontology of Alsace. In furtherance of his object, which is not a mere compilation, but an original work, in which each order, genus, and species is to be considered in its totality as well as in its details, and to be treated of in a large and general manner, he has visited the principal museums of the Continent, and twice or oftener those of England, making a lengthened sojourn on each occasion.

It remains to add a sketch of the general arrangement of the work, which is lucid and practical. The whole will be comprised in two thick octavo volumes, accompanied by 100 lithographic plates in quarto. Of these the first volume, of 738 pages, and 50 plates, is on sale, at the extremely moderate price of 50 francs, and appears to be exceedingly well done. The commentaries on many of the involved and obscure, though prevalent orders, as Equisetæ, are in particular well worthy of an attentive study; and as a specimen of the condition of the science as Dr. Schimper finds and leaves it, and of the extreme difficulty of the subject, we give an analysis of the contents of one tribe of this order; namely, the Calamiteæ. Of these he retains the nine following genera:—

1. *Calamites*, with seven supposed good species, under which species of three other genera are brought, with twenty-six synonyms, of which fourteen belong to one species alone; and there are, besides, nine doubtful species of the genus.
2. *Calamocladus*, with five species, under which are brought plants previously referred to no fewer than *nine other genera* (two species having respectively seven and eight synonyms).
3. *Calamostachys*, with five species, some of which have been referred to three other genera.
4. *Huttonia*, a monotypic genus.
5. *Macrostachya*, with one species, rejoicing in seven synonyms, of which four are generic.
6. *Bornia*, with three species, of which one has six synonyms.
7. *Sphenophyllum*, with seven species, having thirty-two synonyms amongst them, besides three doubtful species.

8. *Annularia*, with six species, having twenty synonyms, and including plants previously referred to six other genera.

The ninth genus, *Aphyllostachys*, is altogether doubtful.

It needs indeed a bold systematist to attack such a chaos as this reveals, and an able one to deal with it effectively and well.

The work will consist of three parts :—(1) an introduction ; (2) a botanical classification of all known fossil plants ; (3) a synopsis of them in geological sequence ; with a Bibliographical Index.

The introductory part is very full, and is comprised in ten chapters :—

Chap. I.—Historical sketch.
Chap. II.—On the state of preservation of fossil plants.
Chap. III.—Distribution of fossil plants in different formations.
Chap. IV.—Different modes of preservation.
Chap. V.—Principles to be followed in the determination of ossil plants.
Chap. VI.—Of the changes which have taken place in the vegetable kingdom from its first appearance up to the present time.
(§ 1.) Disappearance of species ;
(§ 2.) The renewal of floras by the appearance of new types.
Chap. VII. General *coup d'œil* of the floras of different geological periods.
(1.) First epoch. Reign of the Thalassophytes.—(2.) Second epoch. Reign of the vascular Cryptogams.—(3.) Third epoch. Reign of the Gymnosperms. Appearance of Monocotyledons.—(4.) Fourth epoch. Reign of the Angiosperms. (*a*) First period ; Apetalous plants. (*b*) Second period ; Dialypetalous plants. (*c*) Third period ; Gamopetalous plants.
Chap. VIII.—Application of vegetable palæontology to the climatology of the old world.
Chap. IX.—Application of vegetable palæontology to geology.
Chap. X.—General classification of stratified rocks.

Of the above chapters, the sixth, which deals with the renewal of floras by the appearance of new types, will be the first to be read by many, naturally eager to ascertain the views of so able and so unprejudiced a naturalist as Prof. Schimper, on the subject of the Origin of Species. In this matter his views are explicit, and he sums up his reasons for adhering to the doctrine of evolution in the following terms :—

In spite, then, of the deficiency of palæontological documents, we cannot mistake the general line which Nature has followed through the various geological epochs, from the first appearance of organic beings to the period of their present development. This line may be termed one of evolution, because it marks a progressive change from inferior to superior, from simple to compound, precisely similar to that of every individual with a complicated organisation. All agree that the latter is the result of a continued series of metamorphoses. Every organised being begins as a simple cell ; the embryo itself being a complex organism derived from the generating cell ; wherefore there are naturalists who trace the individual back to the cell. We know, in fact, that each living vegetable cell can give birth to a new individual, of which it is in a certain sense the first representative. Many species of vegetables and animals do not rise above this simple cell ; as soon as this has given birth to a second cell, the latter becomes in its turn a fresh individual. Whenever the derived cells remain united, so that a sort of solidarity is established amongst them, the being which is born from this agglomeration is a complex being. It will be so much the more perfect, it will occupy a step so much the higher in the scale of organisms, as the differentiation of functions produced by the metamorphosis of the cells is more complete, and the organs applicable to these functions are more independent of each other.

Has Nature followed this plan in her organic kingdom ? From all that we know, I believe that we are justified in such a conclusion. The only unicellular fossil plants with which we are acquainted are the Diatoms, which have left their siliceous shells in the most ancient of fossil beds. The cellular plants of the family of Algæ are doubtless rare in the palæozoic formations ; with the exception of some little epiphytal fungi, no terrestrial cellular plants have been discovered, either in palæozoic or in mesozoic beds ; this class is even but meagrely represented in the tertiary flora, which has nevertheless much affinity with that of the present day. Nevertheless, these scanty remains suffice to convince us that, if the cellular plants which were to prepare for the arrival of vascular plants have not left numerous and striking traces, they have none the less existed, and doubtless since the earliest periods. The first vegetation on the lands which had just appeared above the waters must have been composed of cellular plants, of Confervæ, of *proembryos* or *prothalliums* of a lower or higher order of Cryptogams, as may be seen at the present day on recently reclaimed land.

The terrestrial vegetation of the Silurian epoch and of the commencement of the Devonian having left no trace, it is impossible for us to judge what were the forms of the plants which then covered the reclaimed land. All that we know is, that the primeval ocean was peopled by a numerous fauna during thousands of centuries before the appearance of vascular cryptogamic acrogens : similarly, if the Thalassophytes of those distant epochs had left no trace, their existence would be none the less infallibly proved by that of the animals whose food they formed.

The rapid glance which we are about to give of the general character of the floras which have succeeded each other on the surface of the earth, from the Devonian period up to the present time, will show better than any reasoning the progressive march which they have followed, and the close links by which they are united to each other.

J. D. HOOKER

HARCOURT AND MADAN'S PRACTICAL CHEMISTRY

Exercises in Practical Chemistry. By A. G. Vernon-Harcourt, M.A., F.R.S., Sec. C. S. ; and H. G. Madan, M.A., P.C.S., Fellow of Queen's College, Oxford. Crown 8vo., pp. 350, 66 woodcuts ; 7*s.* 6*d.* (Oxford : Clarendon Press, 1869.)

WE are glad at last to welcome a really scientific work on Practical Chemistry. Professor Harcourt and Mr. Madan have earned the warm thanks of all interested in the teaching of the science by the publication of their volume. Almost all former works on practical chemistry have been contented either to act the part of illustrated catalogues of chemical apparatus, or else they consist of cut and dried receipts for following out a system of qualitative analysis by reference to a complicated series of paragraphs, ingeniously arranged to bewilder the unfortunate student as much as possible, or they place in his hands tabular statements of reactions which have to be worked through almost always without rhyme or reason.

Mr. Madan's Ten Commandments, or "Memoranda," placed at the commencement of the volume, might well be printed in letters of gold in every laboratory, and repeated as the morning lesson of each first year's student. "Cleanliness," he begins, "stands at *the head* of the *chemist's* scale of virtues." No better advice can be given : if a student can work neatly, he is almost sure to work well. Only rarely can the "messy" beginner be trained to habits of exact experimentation and accurate thought. The second ordinance is equally important : "Do not work in a hurry. What is expended in time is often gained in power and grasp of a subject. Yet, on the other hand, learn to be economical of time." The main object of a certain class of students seems to be to get "through" with their experiments, no matter how clumsily they manipulate, or how small and incomplete may be their knowledge of what the experiment teaches. They are satisfied to have "done the thing," and if they do not